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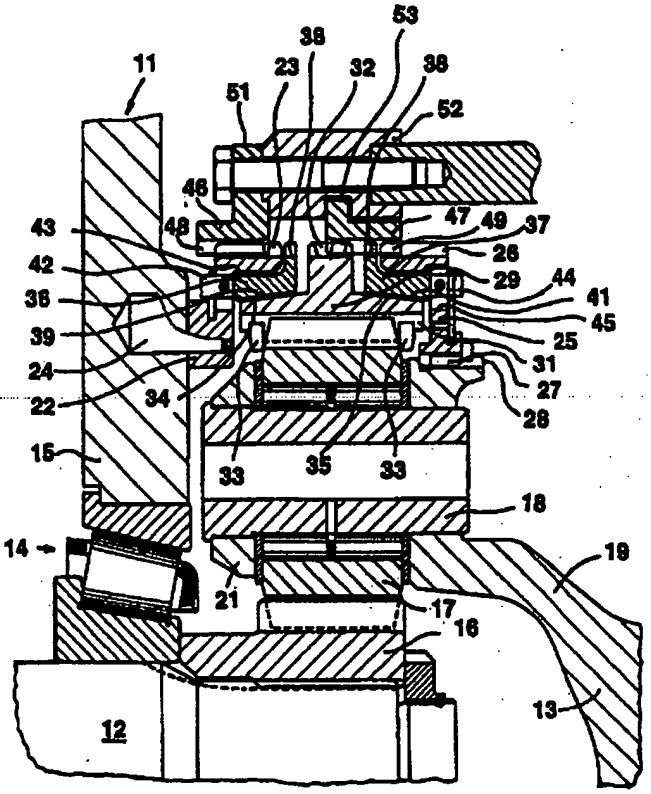
(54) Title: PLANETARY GEARING

(57) Abstract

Planetary gearing comprising a sun gear (14), planet gears (17) disposed around the sun gear and rotatably connected to an output shaft (13), and a ring gear (29) disposed around the planet gears (17). A clutch ring (22, 25) and a synchronising ring (36, 37) are located one on each side of the ring gear (29) and a pair of clutch sleeves, arranged externally of the clutch rings (22, 25), synchronising rings (36, 37), and ring gear (29), are displaceable to couple the ring gear (29) with, or disengage the ring gear (29) from, the output shaft (13). The clutch sleeves (46, 47) may be displaced by a shaft (52).



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Planetary Gearing

Field of Invention

This invention relates to planetary gearing according to the preamble to attached claim 1. Such a planetary gear is used in particular but not exclusively for auxiliary gear boxes intended in use to be inserted between a main gear box and a transmission to the driving wheels of a motor vehicle, especially heavy duty trucks.

Background of Invention

Auxiliary gear boxes are typically used for doubling the number of gear change possibilities and usually comprise planetary gearing by means of which the gear change possibilities of the vehicle can be diverted into a low gear range and a high gear range. In the high gear range there is no gear reduction to the planetary gearing system, and in the low gear range use is made of the gear changing in the planetary gearing system.

One known embodiment of planetary gearing is disclosed in European Patent EP-B-239,555 which describes planetary gearing in which the input shaft is rotatably fast with the sun gear of the planetary gearing, and the output shaft is rotatably fast with a planet wheel carrier. The ring gear of the planetary gearing is connectable to either a fixed wall or the like of the gear box housing or directly to the input shaft for obtaining low range or high range of the gear box.

Another known system of planetary gears is described in SU-A-914843 in which there is disclosed a clutch means and a synchronising means on either side of the ring gear. The ring gear is stationary in the axial direction and externally carries a clutch sleeve that is movable for engagement with either of the two clutch means when changing gear.

The present invention seeks to provide planetary gearing similar to that described in SU-A-914843 which is more axially compact.

Statement of Invention

Accordingly there is provided a planetary gearing according to the characterising part of claim 1. The dependent claims relates to preferred embodiments of the invention.

Preferably the second clutch ring is rotationally fast with the output shaft, preferably through intermeshing teeth at the inner radial portion of said second clutch ring.

Conveniently the sun gear on the output shaft intermeshes with a plurality of circumferentially spaced planet gears.

Preferably the planetary gearing houses a pair of synchronising rings located one on each axial side of the ring gear between the ring gear and a respective clutch ring characterised that each synchronising ring has external teeth for meshing with the internal teeth on the clutch sleeves.

Preferably the gearing further includes a shift shaft having one end connected to a first of said clutch sleeves slidably mounted on the external teeth the first clutch ring so that the shaft is supported for axial movement on the gearbox housing via the first clutch ring.

Description of Drawings

The invention will be described by way of example and with reference to the accompanying drawings in which:

Fig. 1 is a longitudinal section through planetary gearing according to the invention showing only a portion above the longitudinal axis of rotation and with the gearing in a high range condition, and

Fig. 2 is a similar drawing to that of Fig. 1 showing the gearing in a low range condition.

Detailed Description of Invention

With reference to the drawings there is shown a part section through an auxiliary gear box for fitting to the main gear box of a heavy vehicle such as a truck or bus.

The auxiliary gearbox comprises a housing 11 having an input shaft 12 passing therein from the main gearbox not shown. The input shaft 12 is rotatably mounted in the main gear box and housing 11 by bearings 14 mounted in an inner end wall 15 of the housing 11.

A sun gear 16 is mounted rotatably fast with the input shaft 12 by means of splines. The sun gear 16 is formed with external teeth which mesh with at least one, and preferably a plurality of, for example five, circumferentially spaced planet gears 17. Each planet gear 17 is

rotatably mounted on a tubular stub shaft 18 one end of which is secured to a planet gear carrier 19 and to the other of which is secured a planet gear keeper 21. The planet gear keeper 21 retains the respective planet gear on its respective stub shaft 18. The planet gear carrier 19 is integral with an output shaft 13 which is rotatably mounted in an outer end wall not shown on the gear box housing 11 coaxially with the input shaft, as is well known in the art, typically by means of bearings as shown for the input shaft.

A first clutch ring 22 formed with external axially extending teeth 23 is mounted coaxially of the shaft 12 rotationally fast on the gearbox housing inner end wall 15 by means of pins 24, to one side of the planet gears.

A second clutch ring 25 formed with external axially extending teeth 26 is coaxially mounted rotationally fast on the planet gear carrier 19 by means of teeth or splines 27 on its radially inner peripheral margin engaging with like teeth or splines 28 on the planet gear carrier 19. The second clutch ring 28 is located on the other side of the planet gears 17 from the first clutch ring 22.

A coaxial ring gear 29 is located axially between the two clutch rings 22, 25 and concentrically with sun gear 16 and enclosing the planet gears 17. The ring gear 29 has internal teeth 31 for meshing with the planet gears 17, and external teeth 32 which are in radial alignment with and have the same form as the external teeth 23 , 26 on the two clutch rings 22 , 25. The coaxial ring gear 29 is held in axial alignment with the planet gear 17 by a pair of internal circlips 33. The external teeth 32 are located axially centrally of the ring gear 29 which is then formed on each axial side thereof with lesser diameter frustoconical shoulders 34, 35. The two frustoconical shoulders 34, 35 form outwardly directed friction surfaces which are intended for connection with corresponding inwardly directed friction surfaces on a pair of synchronising rings 36, 37.

The two coaxial synchronising rings 36, 37 are arranged with a first synchronising ring 36 located axially between the first clutch ring 22 and the ring gear 29, and a second synchronising ring 37 located axially between ring gear 29 and the second clutch ring 25. Each synchronising ring 36, 37 is formed with external teeth 38 with are radially aligned with the teeth 23, 26 on the two clutch rings 22, 25 and has a radially inwardly directed frustoconical surface 39, 41 for engagement with the like surfaces 34, 35 on the ring gear 29. The first

synchronising ring 36 has axially extending bars 42, sometimes called cogs, that engage with circumferential play in apertures 43 in the first clutch ring 22. The synchronising ring 36 is spring biased, out of the paper, by spring means acting between the bars 42 of the synchronisation ring 36 and the sides of the apertures 43. Similarly the second synchronising ring 37 has axially extending bars 44 which engage with circumferential play in apertures 45 in the second clutch ring 25. The second synchronising ring 37 is spring biased oppositely to the first synchronising ring 36 also by spring means acting between the bars 44 and the sides of the apertures 45.

External of the clutch rings 22, 25 and the ring gear 29 are located a pair of axially spaced coaxial clutch sleeves 46, 47. Each clutch sleeve 46, 47 has internal teeth 48, 49 for mesh with the external teeth 23, 38, 32 , 26 on the clutch rings 22, 25 ring gear 29 and synchronising rings 36, 37. The axially inner sleeve 46 has a flange 51 which is secured, preferably bolted, to a gear shift control shaft 52. The axially outer sleeve 47 is also axially fixed to the shaft 52 and is axially spaced from the first sleeve 46. The second sleeve 47 is rotatably located in a slot 53 in the shaft 52 so that the sleeve 47 can rotate around its axis relative to the shaft 52.

The first sleeve 46 acts as a bearing support for the shaft 52 since it rests on the clutch ring 22 which is fixed to the housing 11.

The planetary gearing described above functions as described below. In figure 1 of the accompanying drawings the inner teeth 31 of the ring gear 29 connect with the planet gear 17. The outer teeth 32 of the ring gear 29 engage with the second clutch ring 25 through the second clutch sleeve 47. Since the ring gear 29 is fixed relative to the output shaft 13 by the clutch sleeve 47, the output shaft 13 will rotate at the same speed as the input shaft 12.

When the low gear range of the planetary gearing is engaging the gear shift operates to move to the right displacing the two clutch sleeves 46 , 47 rightwards from the condition shown in Fig. 1 to the condition shown in Fig. 2. When the gear range change takes place under operating conditions the clutch sleeves 46 , 47 are displaced simultaneously and the second sleeve 47 disengages from the external teeth 32 of ring gear 29 and slides freely onto the second clutch ring 26, as the first clutch sleeve 46 engages with the first synchronising ring 36 pushing the respective friction surface 39 against the frustoconical shoulder 34 on the ring

gear 29. The ring gear 29 is free to rotate relative to the output shaft 13 and is slowed down relative to the housing by the frictional engagement between the frustoconical surfaces 34, 39 on the first synchronising ring 36 and ring gear 29 respectively.

This develops a torque load on the synchronising ring 36 causing rotational movement of the synchronising ring 36 relative to the clutch ring 22 against the spring bias and blocks further rightwards movement of the first clutch sleeve 46 until the torque load is reduced allowing realignment of the teeth on the first synchronising ring 36 and the sleeve 46. The two clutch sleeves 46 , 47 can then be moved fully home rightwards to the condition shown in Fig. 2.

To reengage the high gear range shift control shaft 52 is displaced leftwards in fig. 2. If the gear shift takes place during running it will be necessary to stop rotation of the ring gear 29 relative to the output shaft 13.

The second sleeve 47 will first engage the second synchronising ring 37 which will be pushed against the ring gear 29 so that frustoconical inner surface 41 engages the like shoulder 35 on the ring gear 29 developing a torque load on the second synchronising ring 37 causing it to move against the bias of the spring means in the opposite rotationl direction to the first synchronising ring 46 . This movement may block engagement of the teeth 49 on the sleeve 47 with the external teeth 32 on the ring gear 29 until such time as the torque load is reduced and the spring bias causes the teeth 38 on the second synchronising ring 37 to re-align with the teeth 49 on the sleeve 47. The shaft 52 then pushes the sleeve 47 over the ring gear reengaging the high gear range.

The second clutch sleeve 47 is free to rotate relative to the shaft 52 during the above operations.

In another embodiment of the invention the second clutch ring 25 could be fixed to the sun gear or input shaft.

The above described gearbox has the advantage that it is axially short, with short overhang for the sun gear, and has small rotating and displaceable masses.

Furthermore the number of teeth 23,48 on the clutch rings 22, 25 can differ from the number of teeth 31 on the ring gear 29. This gives a greater number of different combinations for connections thereby reducing problems with sun gears having facetted teeth caused by having only a few combinations.

Claims

1. Planetary gearing comprising a gear box housing (11), an input shaft (12) rotatably mounted in the housing (11), a sun gear (14) which is fixed to the input shaft (12), at least one planet gear (17) disposed around and meshing with the sun gear (14) and rotatably mounted to an output shaft (13), a first clutch ring (22) having external teeth (23) and being rotationally fixed to the gearbox housing (11), a second clutch ring (25) also having external teeth (26) and being rotationally fast with one of the output shaft (13) or input shaft (12), a ring gear (29) having internal teeth (31) that mesh with the or each planet gear (17) and external teeth (32), **characterised** in that a pair of axially spaced clutch sleeves (46) (47) are arranged externally of the clutch rings (22) (25) and ring gear (29), said clutch sleeves (46) (47) having internal teeth (48) (49) capable of meshing with said external teeth (23) (26) (32) and being axially displaceable for connecting the ring gear through one of said sleeves (46) (47) to either one of the two clutch rings (22) (28).

2. Planetary gearing as claimed in Claim 1, having a pair of synchronising rings (46) (47) located one on each axial side of the ring gear (29) between the ring gear (29) and a respective clutch ring (22 or 25) **characterised** in that each synchronising ring (46) and (47) has external teeth (38) for meshing with the internal teeth (48, 49) on the clutch sleeves (46, 47).

3. Planetary gearing as claimed in Claim 1 or Claim 2, **characterised** in that each synchronising ring (46) (47) has axially extending bars (42, 44) on one side thereof which mesh with the apertures (43, 45) in a respective clutch ring (22, 28), and has a frustoconical surface (41, 42) on the other side thereof which engages a like respective frustoconical surface (34, 35) on the ring gear (29).

4. Planetary gearing as claimed in any one of Claims 1 to 3, **characterised** in the second clutch ring (25) is rigidly connected to the output shaft (13).

5. Planetary gearing as claimed in Claim 4, **characterised** in that the second clutch ring (25) is rigidly connected to the output shaft (13) through intermeshing teeth (27) (28).

6. Planetary gearing as claimed in any one of Claims 1 to 5, **characterised** in that there is further included a shift shaft (52) having one end connected to a first of said clutch sleeves (46) which is slidably mounted on external teeth (23) of the first clutch ring (22) so that the shaft (52) is supported for axial movement on the gearbox housing (11) via the first clutch ring (22).

7. Planetary gearing as claimed in Claim 6, **characterised** in that second clutch sleeve (47) is also axially fixed to the shift shaft (52) and is slidable on the external teeth (26) of second clutch ring (25), the two rings (46) (47) being spaced apart such that only one of said clutch sleeves (46 or 47) connects the ring gear (29) with a respective clutch ring (22 or 52) at any time.

8. Planetary gearing as claimed in Claim 6 or Claim 7, **characterised** in that the second clutch sleeve (47) is journaled to the shaft (52) so that it can rotate relative to the shaft (52).

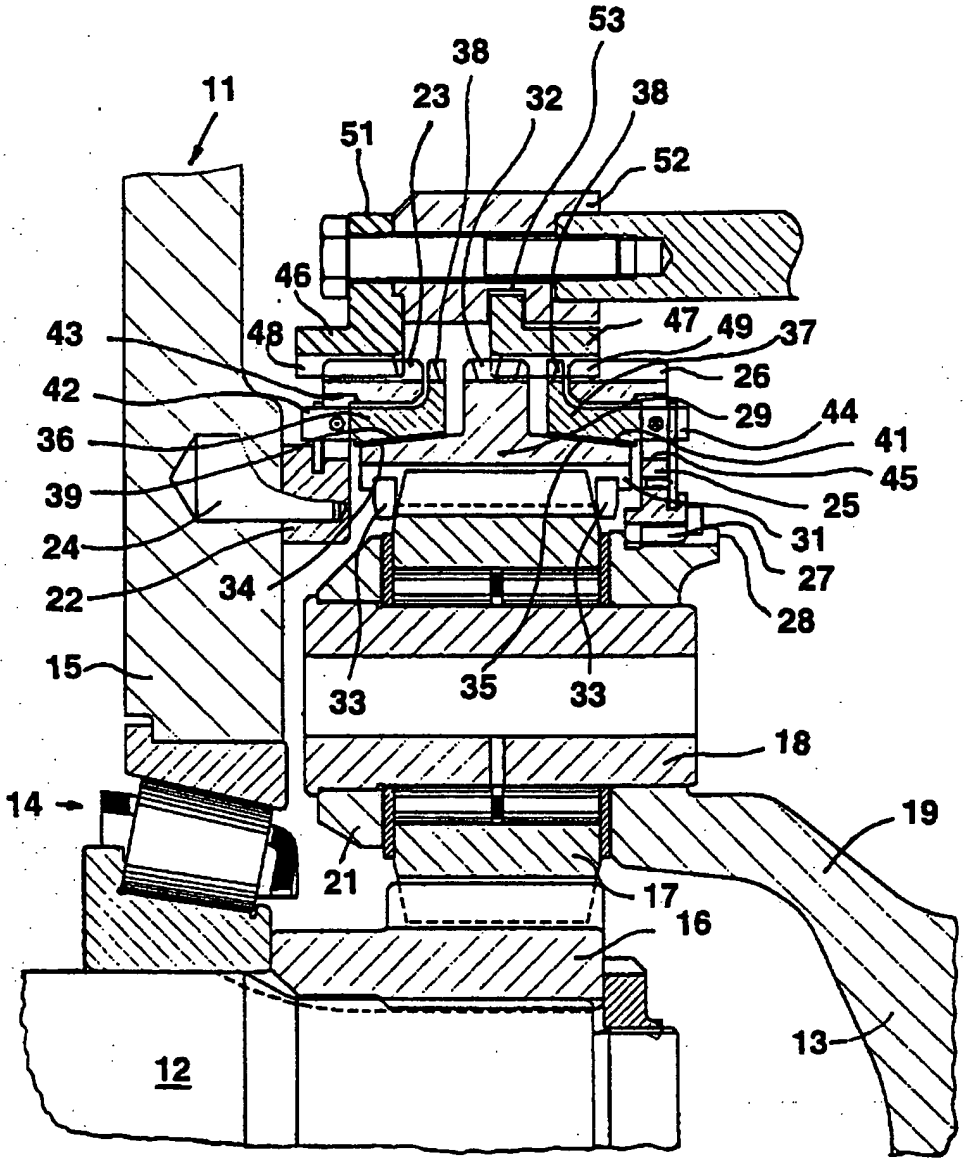
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Fig 1

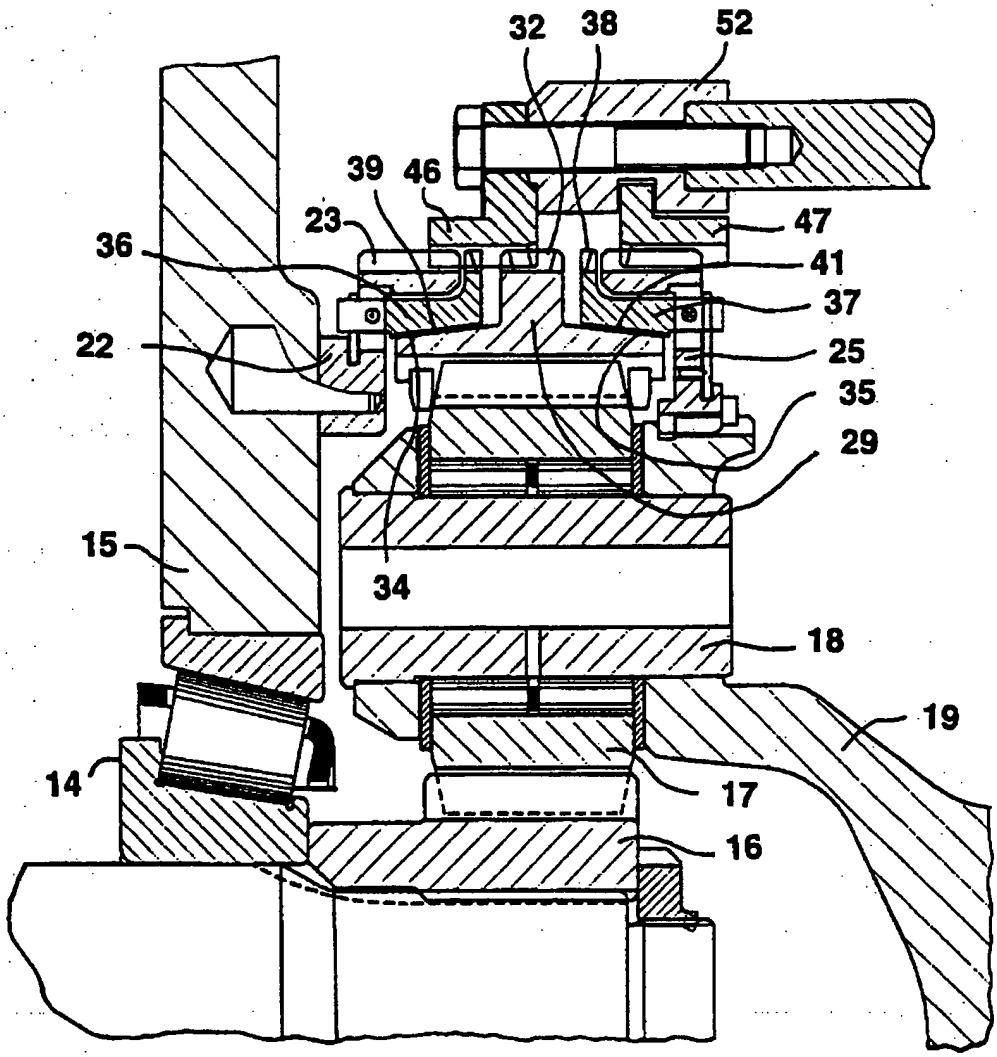

Fig 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/01547

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16H 3/78, F16D 23/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16H, F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5083993 A (ÖUN), 28 January 1992 (28.01.92) --	1-8
A	EP 0239555 A2 (SAAB-SCANIA AKTIEBOLAG), 30 Sept 1987 (30.09.87) --	1-8

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Date of the actual completion of the international search	Date of mailing of the international search report
6 March 1996	16.04.96
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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5083993	28/01/92	DE-D,T- 69008994	01/12/94
		EP-A,B- 0423863	24/04/91
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